

Phyto-pharmacology of *Acalypha indica*: A Review

B.Dineshkumar¹, P.Vigneshkumar², SP.Bhuvaneshwaran², Analava Mitra^{1*}

¹School of Medical Science and Technology, Indian Institute of Technology Kharagpur, INDIA

²Department of Biotechnology, KSR College of Technology, Tiruchengode, INDIA

analavamitra@gmail.com, amitra@adm.iitkgp.ernet.in

ABSTRACT:

Acalypha indica, is an important Indian medicinal plant and widely used in Ayurveda and siddha for management of various diseases. This aims a comprehensive of the chemical constituents, pharmacological and clinical uses. Different pharmacological experiments in both *in vitro* and *in vivo* have been carried out and also identified the medicinally important phyto-constituents. A number of biological constituents in good yield and some have been shown to possess useful biological actions belonging mainly to tannins, flavonoids, cyanogenic glucoside (acalyphin), pyranoquinolinone alkaloid (flindersin). Extracts and chemical constituents of this plant possess useful pharmacological activities. The main pharmacological activity of *Acalypha indica* is wound healing effect, anti-venom property and anti-fertility activity. Many pharmacological studies of *Acalypha indica* have been demonstrated for their antioxidant, antimicrobial, anti-inflammatory, anti-diabetic, wound healing effect, anti-venom and anti-fertility activities, supporting its traditional uses. Suggest a wide range of clinical applications for the treatment of anthelmintic, cathartic, diuretic, emetic, expectorant. Hence, this review contributes to the knowledge of *Acalypha indica* plant and their ethnopharmacological uses.

Keywords: *Acalypha indica*, Biological constituents, Ayurveda, Therapeutic uses.

INTRODUCTION

The plant *Acalypha indica* is commonly known as Indian *Acalypha* and it belongs to the family Euphorbiaceae. The common names of *Acalypha indica* are Indian *Acalypha* (English), Brennkraut (German), Alcalifa (Brazil), Ricinela (Spanish). It is a common annual herb found mostly in waste places and fields in Southern Nigeria and West Africa since it has anthropogenic tendencies towards settled areas. It is also widespread across Asia, backyards of houses and waste places throughout the plains of India [1].

The *Acalypha indica* plant is reported to have some of the therapeutic properties which are used in Siddha and Ayurveda as medicines. This plant has been reported to be useful in the treatment of pneumonia, asthma, rheumatism, several other ailments and also an emmenagogue. The parts of the plant which are used for therapeutic activities are leaves, roots, stalks (young shoots) and flowers [2, 3]. The plant *Acalypha indica* is a small erect herb up to 60 cm tall with a few ascending branches which are angled and pubescent. The leaves are broadly ovate, sub deltoid, rather coarsely toothed on petioles longer than the 3-5 cm and pinnately arranged. The stipules are minute and flowers are sessile on erect axillary spikes longer than the leaf. The male flowers are minute and crowded distally with 8 stamens. The female flowers are scattered along the inflorescence axis, each subtended by a conspicuous semicupular

foliaceous toothed green bract nearly 7 mm long [4]. The plant is bitter to taste. It is used in case of acrid, diuretic, cathartic, expectorant, ernetic, anodyne, hypnotic, gastrointestinal irritation, laxative, bronchitis. It is annual herb have numerous long, angular branches, covered with soft hair. It has thin egg shaped leaves with smooth surface. There has been a tremendous interest in this plant as evidenced by the huge research work. Therefore, we aimed to compile an up to date and comprehensive review of *Acalypha indica* that covers its traditional and folk medicine uses, phytochemistry and pharmacology [5].

SYNONYMS

Tamil	Kuppivaeni, Kuppaimeni
Malayalam	Kuppamani
Telungu	Kuppichettu, Harita-manjiri, Kuppinta or Muripindi
Hindi	Kuppu, Khokali
Sanskrit	Arittamanjarie
English	Indian acalypha
Gujarati	Vanhi Kanto
Uriya	Indramaris
Sinb	Kupa-menya
Sinhalese	Kuppsamenia

MORPHOLOGY

The leaves are 2.5-7.5cm long and 2-2.5cm broad. The shape of the leaves are said to be ovate or rhomboid and ends as acute or sub-obtuse. The leaves have crenate-serrate margin.

In addition base of the leaf is wedge shaped or cuneate. The petioles are slender and usually longer than blade. They have minute stipules. The flowers are unisexual in numerous lax and elongate axillary spikes. The male flower is minute, terminal or axillary. The female flowers are larger than the male flowers and are scattered in arrangement. They are leafy, truncate, having denticate connective anther, cinciniform. It contains many nerved bract and 6-8mm in diameter. The fruits are small and hairy. The seeds are minute, ovoid in shape and pale brown in colors. The capsules are small, hispid, quite concealed by the bract. It can grow up to 75cm in height [6, 7].

ACALYPHA INDICA: USE IN TRADITIONAL MEDICINE

IN AYURVEDA

The ayurvedic formulations of *Acalypha indica* are used in the form of infusion, powder, succus (expressed juice), tincture, liquid extract, cataplasm and decoction. The leaves of *Acalypha indica* possess laxative properties in the form of powder. The mixture of garlic and powder of *Acalypha indica* is used as anthelmintic in worms. The powder of *Acalypha indica* mixed with salt are applied to scabies and its juice in combination with oil can be used as a remedy for rheumatic arthritis. Expressed juice of the leaves is used as an emetic for children, in smaller doses it is expectorant and is also useful in chronic bronchitis, asthma, to relieve the pain of snake bites. The decoction is used for ear-ache and cataplasm of the bruised leaves is applied to syphilitic ulcers. The powder of dry leaves is used as a remedy for bed sores and the infusion of the root acts as a cathartic. [8].

PHYTOCHEMISTRY OF ACALYPHA INDICA

Seven cyanopyridone derivatives (Acalyphin, Epiacalyphin, Noracalyphin, Epinoracalyphin, Acalyphin amide, Epiacalyphin amide cycloside, ar-Acalyphidone and one corresponding seco compound (seco-Acalyphin) have been isolated from methanolic extract of *Acalypha indica* leaves [9]. The biochemical constituents of *Acalypha indica* are tannins, flavonoids, cyanogenic glucoside acalyphin, acalyphamide, aurantiamide, succinimide and the pyranoquinolinone alkaloid flindersin. Further, four known kaempferol glycosides such as biorobin, nicotiflorin, clitorin and mauritianin have been isolated from the dried methanol extract of freeze-dried flowers and leaves of *Acalypha indica* [10]. A new cyanogenic glucoside, acalyphin was isolated from the methanol extract of the aerial parts of *Acalypha indica* and its structure was identified by ^1H NMR and ^{13}C NMR as 3-cyano-3- β -D-glucopyranosyloxy-2-hydroxy-4-methoxy-1-methyl-6(2,3-dihydro) pyridine which is a new biogenetic type of cyanogenic glycoside [11]. Cyanogenic glucoside, acalyphin, (-)-(5R,6S)-5-cyano-5- β -D-glucopyranosyloxy-6-hydroxy-4-methoxy-1-methyl-2-(5,6-dihydro)-pyridone and in addition the 6R-epimer of acalyphin, epiacalyphin and the corresponding pair of N-demethyl derivatives are isolated from methanolic extract of the flowers and leaves of *Acalypha indica* and these structures are confirmed by X-ray crystallography [12]. Acalyphine had been used in the treatment of sore gum and also has expectorant and emetic properties [13, 14, 15].

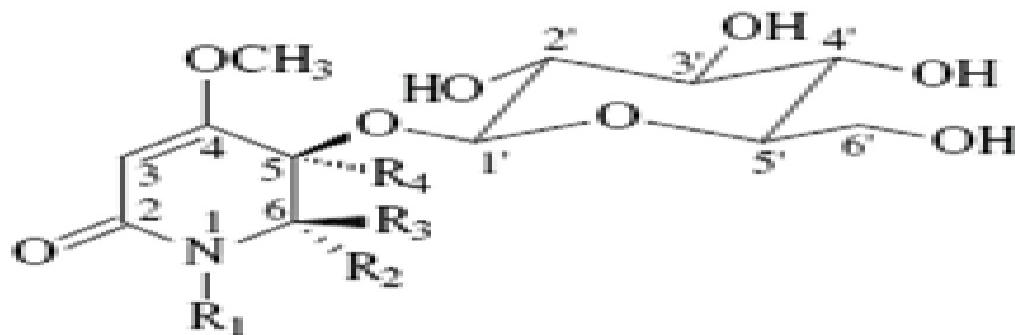
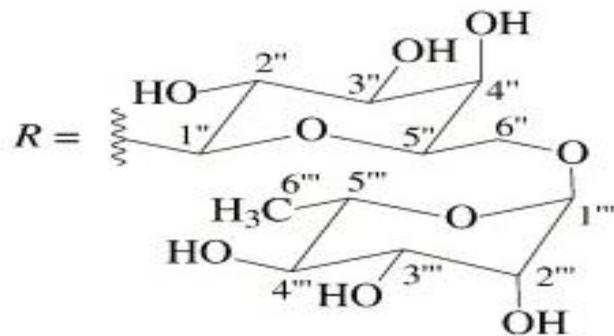


Fig 1: Structure of cyanopyridone



- (1) R = α-L-Rha-(1→6)-β-D-Gal
- (2) R = α-L-Rha-(1→6)-β-D-Glc
- (3) R = α-L-Rha-(1→2)-α-L-Rha-(1→6)-β-D-Glc
- (4) R = α-L-Rha-(1→2)-α-L-Rha-(1→6)-β-D-Gal

Fig 2: (1) R = Biorobin, (2) R = Nicotiflorin, (3) R = Clitorin, (4) R = Mauritianin

POST-COITAL ANTI-FERTILITY ACTIVITY

Four successive solvent extracts such as chloroform, ethanol, petroleum ether and aqueous of the whole plant of *Acalypha indica* are tested for post-coital antifertility activity in female albino rats. Of these, petroleum ether and ethanol extracts at (600 mg/kg body weight) showed estrogenic activity. The chloroform and aqueous extracts do not exhibit estrogenic activity [16].

ANTI-VENOM PROPERTIES OF ACALYPHA INDICA

The ethanol leaf extract of *Acalypha indica* was tested for neutralization activity of Viper russelli (Russell's viper) venom in rats and isolated frog tissue. The results indicated that the ethanol leaf extract in the dose levels of 500 and 750mg/kg inhibited the Viper russelli venom induced lethality, haemorrhage, necrotizing and mast cell degranulation in rats and cardiotoxic, neurotoxic effects in isolated frog tissue in dose dependent manner. The extract also inhibited the venom induced lipid peroxidation in RBC, decreased GSH and catalase levels of rat kidney tissue [17].

WOUND HEALING EFFECT OF ACALYPHA INDICA

The ethanolic extracts of *Heliotropium indicum*, *Plumbago zeylanicum* and *Acalypha indica* were tested for their wound healing activity in rats using excision and incision wound models following topical application. The results indicated that ten percent weight/volume extracts of *Acalypha indica* being prepared with saline showed wound healing activity with low tensile strength (low rate of maturation of collagen) when being compared with *Heliotropium indicum* [18].

EFFECT OF ACALYPHA INDICA ON MALARIAL VECTOR

Different leaves extracts *Acalypha indica* (benzene, chloroform, ethyl acetate and methanol) were tested for larvicidal, ovicidal activity and oviposition attractancy against the malarial vector *Anopheles stephensi*. The results indicated that extracts exhibited promising for larvicidal activity with LC₅₀ values 19.25, 27.76, 23.26 and 15.03 ppm respectively. For ovicidal activity, the percent hatchability is inversely proportional to the concentration of the extracts

and directly proportional to the eggs. The highest oviposition effective attractancy observed was 90.09%, 94.20%, 85.43% and 95.75% for benzene, chloroform, ethyl acetate and methanol extracts respectively [19].

ANTIOXIDANT CAPACITY OF ACALYPHA INDICA

The aqueous ethanolic leaf extracts of *Becium dhofarense*, *Pulicaria crispa*, *Allophylus rubifolius*, *Olea europaea*, *Acacia senegal*, *Pluchea arabica*, *Anogeissus dhofarica*, *Moringa peregrina*, *Cordia perrottetii*, *Ficus lutea* and *Acalypha indica* were tested for antioxidant activity using in vitro DPPH (diphenylpicryl-hydrazyl) assay method. The results showed that all extracts having anti-oxidant activities in DPPH method at 89-93%, after 15 min of incubation at a test concentration of 50 μ g/ml [20].

ANTI-INFLAMMATORY ACTIVITY OF ACALYPHA INDICA

The fresh juice of *Acalypha indica* leaves was investigated for anti-inflammatory activity in four groups of overnight fasted albino rats. All the four groups of animals of six each are pretreated orally with control, standard (Indomethacin), *Acalypha indica* and combination of both *Acalypha indica* and indomethacin one hour before carrageenan injection. Acute oedema was induced in right hand paw of rats by injecting 0.1 ml of 1% carrageenan solution. The paw volume was measured using a plethysmometer at 0-4 hours after injection. The results indicated that fresh juice of leaves of *Acalypha indica* exhibited effective inhibition of paw volume and oedema [21].

ACARICIDAL ACTIVITY OF ACALYPHA INDICA

In vitro acaricidal property of *Acalypha indica* leaves paste was tested for 48h and results showed that maximum inhibition observed after 48h with the suppression of lesions. *In vivo* acaricidal property of *Acalypha indica* leaves was tested for 14days based on the live mite count and lesion score in naturally infested broiler rabbits. The results indicated that *Acalypha indica* leaves paste showed lethal effect on live mites after 4h of treatment [22].

DIURETIC ACTIVITY OF ACALYPHA INDICA

Diuretic activity of methanolic extract of *Acalypha indica* was evaluated in albino mice. The results indicated that *Acalypha indica* showed maximum diuretic action at the dose of 400 mg/kg body weight after five hours of ingestion when compared with standard drug frusemide at the dose of 20mg/kg body weight [23].

ANTIBACTERIAL AND ANTIFUNGAL ACTIVITIES OF ACALYPHA INDICA

The ethyl acetate, hexane and methanol extracts from the leaves, stem and roots of *Acalypha indica* were tested for their antibacterial activities against *Bacillus subtilis*, *Staphylococcus aureus* and *Klebsiella pneumoniae*. The results indicated that the leaves and root extracts of ethyl acetate showed quite promising inhibition of the growth of all three bacterial species and the hexane extracts showed moderate activities [24]. The aqueous extracts of *Tridax procumbens*, *Cleome viscosa*, *Acalypha indica* and *Boerhaavia erecta* at two different weights of residues, 30 and 40mg were tested for antibacterial activities by the filter paper disc diffusion method. The results indicated that maximum inhibition was observed against *Aeromonas hydrophilla* and *Bacillus cerues* [25]. The hexane, chloroform, acetone and methanol extracts of fresh, dried and powdered samples of leaf, stem and roots of *Acalypha indica* were prepared by soxhlet apparatus. The R_f values of the plant extract (0.371 ± 0.0009) and a synthetic antifungal compound, Clotrimazole (0.371) were verified by subjecting to TLC and HPLC analyses. The results indicated that active compound present in root, leaf and stem extracts were 538, 415, 171 μ g/g and showed more potent in controlling *Candida albicans*, *Aspergillus niger* and *Escherichia coli* [26]. The acetone, chloroform, ethanol and diethyl ether extracts of *Acalypha indica*, *Solanum trilobatum*, *Aegle marmelos*, *Adhatoda vasica*, *Aristolochia latas*, *Datura metel*, *Glycyrrhiza glabra*, *Solanum incanum*, *Eucalyptus globulus*, *Azadirachta indica* and *Vitex negundo* were evaluated for antibacterial properties against *Salmonella typhi*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Shigella flexneri* and *Klebsiella pneumonia*. The results indicated that the ethanol plant extract showed best inhibition

amongst the other extracts being used [27]. The hexane, chloroform, ethyl acetate and methanol extracts from the leaves of *Acalypha indica* were evaluated for antibacterial activities against gram positive (*Staphylococcus aureus*, *Staphylococcus epidermidis*, *Bacillus cereus*, *Streptococcus faecalis*) and gram negative (*Klebsiella pneumoniae*, *Escherichia coli*, *Proteus vulgaris*, *Pseudomonas aeruginosa*) bacteria. The results indicated that all the extracts exhibited antibacterial activities against gram positive organisms with the inhibitory concentrations between 0.156-2.5 mg/ml [28].

CONCLUSION

The pharmacological studies conducted on *Acalypha indica* indicate the immense potential of this plant in the treatment of conditions such as wounds, malaria, coughs, inflammatory, diabetes etc. *Acalypha indica* also exhibits antioxidant, antimicrobial, anti-inflammatory, anti-diabetic, wound healing effect, anti-venom and anti-fertility activities. However, the diverse pharmacological activities of *Acalypha indica* extracts and isolated phytochemical have been investigated in laboratory animals and the results obtained may not necessarily be portable to the situation in humans. While there are gaps in the studies conducted so far, which need to be bridged in order to exploit the full medicinal potential of *Acalypha indica*, it is still clear that this plant with tremendous widespread use now and also with extraordinary potential for the future. Further research in phytochemicals development from *Acalypha indica* will help to analyse therapeutic efficacy of products. Efforts are now being made to investigate various therapeutic actions of *Acalypha indica* plant and their products using model systems.

REFERENCES

- [1] Burkhill HM (1994) The useful plants of West Tropical Africa. Royal Botanic Gardens, Kew. United Kingdom 2: 2-636.
- [2] Blaschek W, R. Hansel, K. Keller, J. Reichling, H. Rimpler, G. Schneider. (1998) *Acalypha*. Springer Verlag, Berlin II: 1-5
- [3] Gupta AK, N. Tandon. (2004) Reviews on Indian medicinal plants. Indian Council Medical Research. New Delhi II
- [4] Stone, C. Benjamin. (1970) The flora of Guam, Micronesica. 6:1-659.
- [5] Anjaria J, M. Parabia, G. Bhatt, R. Khamar. Nature heals, 2, SRISTI innovations, 9.
- [6] Nadkarni KM. (2000) Indian Materia Medica. Popular Prakashan, Bombay. 1:17-19
- [7] Panda H (2003) Herbal soaps and Detergents handbook. National institute of industrial research: 48-49.
- [8] Indian Acalypha - Medicinal Properties and Benefits <http://www.home-remedies-guide.com/herbs/indian-acalypha.htm>
- [9] Hungeling M, M. Lechtenberg, F.R. Fronczek, A. Nahrstedt. (2009) Cyanogenic and non-cyanogenic pyridine glucoside from *Acalypha indica* (Euphorbiaceae). *Phytochem.* 70:270-277.
- [10] Nahrstedt A, M. Hungeling, F. Petereit. (2006) Flavonoids from *Acalypha indica*. *Fitoterapia* 77:484-86.
- [11] Nahrstedt A, J.D. Kant, W. Victor. (1982) Acalyphin, A cyanogenic glucoside from *Acalypha indica*. *Phytochem.* 21:101-05.
- [12] Hungeling M, L. Matthias, R.F. Frank, A. Nahrstedt. (2009) Cyanogenic and non-cyanogenic pyridone glucosides from *Acalypha indica*. *Phytochem.* 1-8 (In Press)
- [13] Chopra RN, S.L. Nayar, I.C. Chopra. (1956) Glossary of Indian Medical Plants. New Delhi. CSIR.
- [14] Nadakarni K.M, A.M. Nadakarni. (1982) The Indian Medicinal Plants. Vol II (Popular Prakashan, Bombay).
- [15] Bedon E., Hatfield GM. (1982) An investigation of the antiviral activities of *Podophyllum Peltatum*; *Lloydia* 45:725.
- [16] Shivayogi PH., Rudresh K, Shrishailappa B, Saraswati BP Somnath RP. (1999) Post-coital anti-fertility activity of *Acalypha indica* L; *J Ethnopharmacol* 67:253-58.
- [17] Annie S, K. Rajendran, B. Ramgopal, C. Dinesh Kumar. (2004) Neutralization potential of Viper russelli russelli (Russell's viper) venom by ethanol leaf extract of *Acalypha indica*; *J Ethnopharmacol.* 94:267-73.
- [18] Suresh Reddy J, P. Rajeswara Rao, S.R. Mada. (2002) Wound healing effects of *Heliotropium indicum*, *Plumbago zeylanicum* and *Acalypha indica* in rats. *J Ethnopharmacol.* 79:249-251.
- [19] Govindarajan M, A. Jebanesan, T. Pushpanathan, K. Samidurai. (2008) Studies on effect of *Acalypha indica* L.

- (Euphorbiaceae) leaf extracts on the malarial vector, *Anopheles stephensi* Liston (Diptera:Culicidae), Parasitol Res. 103: 691-95.
- [20] Ruchi GM, O.F. Majekodunmi, M. Ramla, B.V. Gouri, A. Hussain Suad S.B. Khamis. (2007) Antioxidant capacity of some edible and wound healing plants in Oman, Food Chem. 101:465-70.
- [21] Mohana Vamsi N, M. Venkata Sunil Kumar, N. Kodandaram, Y. Padmanabha Reddy. (2008). Evaluation of Anti-inflammatory activity of *Acalypha indica*, Ind Pharm. 7:89-91.
- [22] Singh DAP, M. Raman, V. Saradha, P. Jayabharathi, V.R.S. Kumar. (2004) Acaricidal property of kuppaimeni (*Acalypha indica*) against natural Psoroptes cuniculi infestation in broiler rabbits, Indian J Anim Sci. 74:1003-006.
- [23] Das AK, F. Ahmed, N.N. Biswas, S. Dev, M.M. Masud. (2005) Diuretic Activity of *Acalypha indica*, Dhaka Univ J Pharm Sci; 4:1-2.
- [24] Gangadevi V, S. Sethumeenal, S. Yogeswari, G. Rani. (2008) Screening endophytic fungi isolated from a medicinal plant, *Acalypha indica* L. for antibacterial activity, Indian J Sci Tech. 1:5-6.
- [25] Perumal Samy R, S. Ignacimuthu, D. Patric Raja. (1999) Preliminary screening of ethnomedicinal plants from India, J Ethnopharmacol. 66:235-40.
- [26] Jebakumar Solomon R.D, K. Subramanian, V. Jayaraj. (2005) Isolation and identification study of antimicrobial property of a bioactive compound in an Indian medicinal plant *Acalypha indica* (Indian-nettle), World J Microb Biot. 21:1231-236.
- [27] Prema P. (2004) Antimicrobial activity of selected medicinal plants, J Ecobiol. 16:333-37.
- [28] Govindarajan M, A. Jebanesan, D. Reetha, R. Amsath, T. Pushpanathan, K. Samidurai. (2008) Antibacterial activity of *Acalypha indica* L. Eur Rev Med Pharmacol Sci. 12:299-02.